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process, which was described to the Academy, in the course of which it lost one foot and two entire legs. This summer again, during the latter part of August, the animal moulted; the moult as exhibited is a perfect cast of the large spider—skin, spines, claws, the most delicate hairs all showing, and their corresponding originals appearing bright and clean upon the spider. The moulting occurred during Dr. McCook's absence, but was just finished when he returned. When the cast-off skin was removed it showed, as might be supposed, the dissevered members to be lacking. But on looking at the spider itself, it was seen that new limbs had appeared, perfect in shape but somewhat smaller than the corresponding ones on the opposite side of the body. The dissevered foot was also restored. The loss of the opportunity to see the manner in which the legs were restored during moult was greatly regretted; but we have some clue from the careful and interesting studies of Mr. Blackwall. Several spiders whose members had been previously amputated, were killed and dissected immediately before moulting. In one of these the leg which was reproduced was found to have its tarsal and metatarsal joints folded in the undetached half of the integument of the old tibia. Another like experiment was made with an example of *Tegenaria civilis.* The reproduced leg was found complete in its organization, although an inch in length, and was curiously folded in the integument of the old coxa, which measured only one-twenty-fourth of an inch in length. Dr. McCook's tarantula had lost both legs close up to the coxæ, and in the moult the hard skin formed upon the amputated trunks was wholly unbroken, showing that the skin had been cast before the new leg appeared. We risk nothing in inferring that, as in the case of Blackwall's *Tegenaria*, the rudimentary legs were folded up within the coxæ, and appeared at once after the moulting, rapidly filling out in a manner somewhat analogous to the expansion of the wings in insects after emerging.

Messrs. Henry F. Claghorn and Emanuele Fronani were elected members.

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## OCTOBER 2.

Mr. THOS. MEEHAN, Vice-President, in the chair.

Twenty-eight persons present.

The death of Charles Magarge, a member, was announced.

*The Synchronism of Geological Formations.*—Professor ANGELO HEILPRIN, referring to one of the many vexed problems which from time to time engross the attention of geologists and naturalists, namely, the contemporaneity of geological formations, stated that the order of deposit of the various formations, from the oldest to the newest, was constant the world over, and that nowhere, except where there may have been a reversal of the strata themselves, was there evidence of a reversed position. Corresponding strata, as indicated by the contained fossils, had therefore been supposed to belong to the same age, although occurring in widely separated regions. This view, for a long time maintained undisturbed by the earlier geologists and palæontologists, had, however, been dissented from by Edward Forbes, Huxley, and other advocates of the doctrine of faunal dispersion from localized areas or centres of distribution (opponents of independent creation), on the obvious ground, that faunas starting from a given point of origination could only spread by migration, and that such migration must consume time, proportional to the distance traveled and the physical and physiographical facilities afforded for traveling. Hence it was argued that widely separated formations showing an equivalent faunal facies, as, for example, the Silurian of America and the Silurian of Europe or eastern Asia, or the Cretaceous of Europe and South America, could not be of identical age, and, with a fair show of probability, not even approximately so. In support of this position it has been urged that during the present age of the world the faunas of the several continents are widely distinct, and could, under geological conditions, be considered as indicating different zoological (geological) eras. In conformity with this view, Professor Huxley had proposed (Anniversary Address, Geol. Soc., 1862. Q. J. Geol. Soc., xviii, p. xlvi) the term "homotaxis," indicating similarity of arrangement, in place of synchrony, to describe the relations of distant areas of the same formation.

Pushing his conclusion to what appeared to be its furthest legitimate point, Professor Huxley deduced therefrom two important considerations:

I. That formations exhibiting the same faunal facies may belong to two or more very distinct periods of the geological scale as now recognized; and conversely, formations whose faunal elements are quite distinct, may be absolutely contemporaneous; *e. g.:* "For anything that geology or palæontology is able to show to the contrary, a Devonian fauna and flora in the British Islands may have been contemporaneous with Silurian life in North America, and with a Carboniferous fauna and flora in Africa" (*loc. cit.*).

II. That, granting this disparity of age between closely related faunas, all evidence as to the uniformity of physical conditions over the surface of the earth during the same geological period (*i. e.*, the periods of the geological scale), as would appear to be indicated by the similarity of the fossil remains belonging to that period, falls to the ground. "Geographical provinces and zones may have been as distinctly marked in the Palæozoic epoch as at present, and those seemingly sudden appearances of new genera and species, which we ascribe to new creation, may be simple results of migration."

These views, enunciated by Prof. Huxley, were still largely held, Prof. Heilprin maintained, by a very large body of geologists. But it can readily be shown by a logical deduction that at least one of the conclusions arrived at (I) is, in almost certainty, erroneous; and that the second, based upon this one, derives no confirmation from the supposed facts. If, as is contended, several distinct faunas—*i. e.*, faunas characteristic of distinct geological epochs—may have existed contemporaneously, then evidences of inversion in the order of deposit ought to be common, or, at any rate, they ought to be indicated somewhere, since it can scarcely be conceived that animals everywhere would have observed the same order or direction in their migrations. Given the possible equivalency in age, as claimed, of the Silurian fauna of North America with the Devonian of the British Isles and the Carboniferous of Africa, or any similar arrangement, why has it never happened that when migration, necessitated by alterations in the physical conditions of the environs, commenced, a fauna with an earlier facies has been imposed upon a later one, as the Devonian of Great Britain upon the Carboniferous of Africa, or the American Silurian upon the Devonian of Britain? Or for that matter, the American Silurian may have just as well been made to succeed the African Carboniferous. Why has it just so happened that a fauna characteristic of a given period has *invariably* succeeded one which, when the two are in superposition, all over the world (as far as we are aware), indicates precedence in creation or origination, and *never* one that can be shown to be of later birth? Surely these peculiar circumstances cannot be accounted for on the doctrine of a fortuitous migration. Nor can it be claimed that, through the interaction of the evolutionary forces, a migrating fauna with an early-life facies will in each case at the point of its arrest have assumed the character of the later-day fauna which belongs to that position. Therefore it appears inexplicable that a very great period of time could have intervened between the deposition of the fauna of one great geological epoch at one locality, and that of the same or similar fauna at another locality distantly removed from the first. In other words, the migrations, for such must undoubtedly have been the means of the distant propagation of identical or very closely related life-forms (unless we admit the seemingly untenable hypothesis that equivalent life-forms may have been *very* largely developed from independent and very dissimilar lines of ancestry), must have been much more rapidly performed than has generally been admitted by naturalists. (*Sic* Huxley: "All competent authorities will probably assent to the proposition that physical geology does not enable us in any way to reply to this question, Were the British Cretaceous rocks deposited at the same time as those of India, or are they a million of years younger or a million of years older?")

But what applies to the broader divisions of the geological scale also applies to the minor divisions. Thus the subordinate groups of a formation are almost as definitely marked off in the same order, the world over, as are the formations themselves. After breaks in formations the appearance of characteristic fossils is largely the same; whereas, on the theory of synchronism of distinct faunas, such a succession of forms would certainly not be constant. After deducing further evidence from the lithological characters of the rock-masses of the various geological formations, the speaker maintained that the views entertained on the subject by the older geologists were more probably the correct ones, namely: that formations characterized by the same or very nearly related faunas in widely separated regions belonged, in very moderate limits, to approximately the same actual age, and were, to all intents and purposes, synchronous or contemporaneous.

*Longevity of Trees.*—At the meeting of the Botanical Section, October 8, Mr. THOMAS MEEHAN remarked that there was nothing phenomenal in the great age of the mammoth sequoias, as other trees on the Pacific coast exhibited great age. In order to ascertain whether more than one annual circle of wood is formed in each year, he tested the matter in various ways. For instance, a pine or spruce would be found to make an average growth of a foot a year up to fifteen years old; from that to about thirty years, nine inches; from that on, six inches; after that a stage was reached where the erect growth ceased to any considerable extent, and the growth force seemed turned toward the lateral branches. In the pine forests of the Pacific coast, there was no danger of error in fixing the age of the average tree of sixty feet high, at about fifty years. Wherever such a tree was cut down, and an opportunity afforded to count the circles, they would be found to correspond so nearly with the calculated age, as to prove that it was quite safe to assume a single circle for a single year. Then there was a remarkable degree of uniformity in the diameter of these annual growths in most trees, so that when once we had the number of the circular lines to an inch, and the diameter of the tree, we could tell its age near enough for general purposes. In some pine trees growing on very rich soil, he had found as few as about four circles to an inch. For instance, a section of a *Pinus Lambertiana* (in Mariposa), four feet across, had but 189 circles; but here the increased size of the trees corresponds with the larger annual circles. Trees of this species of pine here were not uncommon, measuring thirty, and a few thirty-three feet around. No matter, however, how vigorous may be the growth of trees under fifty or one hundred years, they decrease with age, and we may safely allow six rings to an inch in these older sugar pines, which would make the thirty-three feet tree 396 years old. The outer growths of sequoia were very narrow. He counted as many as eighteen to the inch, while the rings in the interior of cross-sections would show about six to the inch. Allowing twelve as the average per annum, a tree of thirty-three feet diameter would give 2376 years old, which is about the same as given by an actual count of rings. At Harrisburg or Juneau, in lat. 58°, a Sitka spruce (*Abies Sitkensis*) cut down, gave 149 rings from centre to circumference—298 lines, in a trunk three feet across. This gave an average of about eight to an inch in this 149 years old, three feet tree. At Wrangel, lat. 56°30′, a tree of the western hemlock (*Abies Mertensiana*) which had been blown down, and afterwards divided by a cross-cut saw at four feet from its base, gave eighteen lines to an inch, and the annual growths seemed very regular almost to the centre of the tree. It was six feet in diameter, and must have been a grand old tree in its day. It had evidently been broken off years before it was blown down, but the length of this trunk up to where it had been broken was 132 feet, and four feet in diameter at that height. But allowing as much as twelve to an inch, it would give for the point cut across, six feet, an age of 432 years. At Kaigan Harbor, lat. 55°, the Sitka spruces were very large, and of great height. He measured two of the largest, which were twenty-one feet in circumference each. Allowing eight to the inch, as in the tree of the same species at Harrisburg, it gives 336 years as the age of the tree; so far as appearances went, these trees were in the height of vigor, and there seemed no reason, judging from experience in other cases, why these trees might not flourish for a hundred years yet. Mr. Meehan had no doubt that these trees in these latitudes in Alaska, would easily have a life of 500 years.

Turning now to the Atlantic States, we find 200 years as the full average term of life for its forest trees, with the exception, perhaps, of the plane, *Platanus occidentalis*, which is the longest lived of all. Trees famous for longevity in Europe are comparatively short-lived here. In the old Bartram Garden, near Philadelphia, where the trees can be little more than 150 years old, nearly all are past their best. The English oak, *Quercus Robur*, which in England is said to live for a thousand years, has grown to full size and wholly died away in this garden, and the foreign spruces are on the down grade. The great cypress, *Taxodium distichum*, which must have made an average growth of four lines a year, has also begun to show signs of deterioration. Silver firs, *Abies pectinata*, in the vicinity of Philadelphia, known to be planted in 1800, are decaying. This is the general experience.

In seeking for the cause of this difference, we are accustomed to look at the relative humidity of the atmospheres of Great Britain and the Atlantic United States. Evergreens like *Cerasus Laurocerasus*, *Laurus nobilis*, and *Viburnum tinus*, which will endure a temperature of 25° below freezing point in Great Britain, are killed by 10° in Philadelphia; and it is believed by the dryer atmosphere causing a heavier drain for moisture on the vital powers of the plant to supply. A strain which will wholly destroy plants in some instances, must have an enervating influence where it does not wholly destroy, and this would naturally be exhibited in shortening the life of the tree.

The climate of Alaska had the same favoring influences we found in Great Britain. The warm sea of Japan flowed against its southeastern face, along which the trees referred to were found. The atmosphere was always moist, and severe weather almost unknown. At Sitka, in lat 57°, as much as 100 inches of rain had fallen in a single year. The harbor was rarely frozen; boats came in and went out at all times of the year. There were some winters when no ice of any consequence was seen. These were circumstances favorable to longevity in trees.

Mr. Meehan concluded by remarking that Dr. Lindley had said somewhere that his researches had failed to show that there was any period of duration of life set for any tree, and that if circumstances favored there seemed no reason why trees might not live for an indefinite period, and, therefore, arguments offered in connection with the " wearing out of varieties," based on what is called the " natural life of a tree," had little force. Mr. Meehan believed his observations on the longevity of trees on the Pacific confirmed Dr. Lindley's views. At any rate, there seemed nothing phenomenal in the age of the *Sequoia gigantea*, as other species partook of similar longevity to a great extent.

Prof. Angelo Heilprin was elected Curator, to fill the vacancy caused by the death of Charles F. Parker.

## OCTOBER 9.

The President, Dr. LEIDY, in the chair.

Thirty-two persons present.

The Council reported the appointment of Prof. Angelo Heilprin as Actuary to the Curators, or Curator-in-charge.

*Mineralogical Notes.*—Dr. LEIDY exhibited a large crystal of topaz, from Mursinsk, Siberia. It is pale blue, with perfect termination, and weighs three pounds three ounces. He also exhibited large cut specimens of white topaz and rich green beryl, which had met with a curious accident. The two, in unpacking, had been violently struck together, and the former had been broken through the middle so as to exhibit a perfect cleavage.

## OCTOBER 16.

Mr. THOS. MEEHAN, Vice-President, in the chair.

Thirty-seven persons present.